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DEPARTMENTS.

SOLUTIONS OF PROBLEMS.

ALGEBRA.

364. Proposed by J. SCHEFFER, A. M., Hagerstown, Md.

The English physicist, Hooke, published the discovery contained in the Latin sentence, "Ut tensio sic vis" by the cypher *ceiiinossssttuv*. Preserving the lexicographical order, find which permutation, taking all letters, the Latin sentence is from the cypher.

Solution by H. C. FEEMSTER, A. M., York College, York, Nebraska.

Beginning at the first, and counting all permutations, although letters may be alike, the permutation required is:

$$12|\underline{13}+10|\underline{12}+|\underline{10}+4|\underline{9}+5|\underline{8}+|\underline{7}+3|\underline{6}+3|\underline{5}+|\underline{4}+2|\underline{2}+|\underline{1}$$
$$=79,\ 519,\ 555,\ 109.$$

370. Proposed by E. B. ESCOTT, University of Michigan, Ann Arbor, Mich.

Prove that, if the fraction m/p (p prime) gives a recurring decimal with an even number of digits in the cycle, the sum of the two halves will be composed of 9's. (The special case where the number $=p-1$ was proposed in the MONTHLY, Vol. IV, and answered in Vol. V, p. 11. The proof there given, however, is not complete.) The above property is true of other fractions, *e. g.*, $\frac{1}{77}=.\dot{0}1298\dot{7}$, $\frac{1}{133}=\frac{1}{7.19}=.\dot{0}07518796,99248120\dot{3}$. Find for what fractions this is true.

I. Solution by F. H. SAFFORD, Ph. D., University of Pennsylvania.

1°. To prove that the sum of the two halves will be composed of 9's. Let the number of digits in the cycle be $2n$, then the number of 9's in the denominator of the unreduced common fraction will be $2n$, and this sequence is divisible by the sequence of n 9's, *e. g.*, 999999 is divisible by 999. It follows that the unreduced numerator must be also divisible by the sequence of n 9's. Suppose the original cycle is $\dot{a}bcde\dot{f}$, the fraction may be written

$$\frac{(abc)(1000)+(def)}{999999}, \text{ or } \frac{(abc)(999)+(abc)+(def)}{999999},$$

in which (abc), etc., represents a number of three digits and not a product. The part $(abc)+(def)$ must be divisible by 999 as shown by the preceding.